



CRYPTOZOOLOGY

REAL SCIENCE
OR PSEUDOSCIENCE?



EVER SINCE WE WERE YOUNGSTERS, we have been enthralled with ideas about monsters and magnificent creatures with mythic and ancient roots. Indeed, we have never really gotten over being smitten with magical beasts. That is why one of us became a writer and an illustrator of books for young readers about creatures great and small, and the other became a paleontologist who studies the history of life on Earth as revealed through fossils.

To understand the field of cryptozoology, it is necessary to appreciate the core concepts and procedures of science. We begin our investigation with a story about the sighting of one of the most famous cryptids: Bigfoot.

THE GEORGIA “BIGFOOT”

On July 9, 2008, among the usual stories of political news and celebrity scandals, the Internet and televised media were buzzing with a report of two men who supposedly had found a body of Bigfoot in the woods of northern Georgia. In this age of electronic media, the discoverers’ account was posted on YouTube before it was even covered by the conventional televised news or newspapers. The images were blurry and difficult to decipher, but the insatiable twenty-four-hour news and Internet cycle demands filler with some sort of content, no matter how suspicious. Major mainstream media—including the BBC, CNN, ABC News, and Fox News—gave the story considerable coverage.¹ Even if some news announcers read this, like other Bigfoot stories, with a tone of incredulity or mocking sarcasm, the media nonetheless reported the Georgia Bigfoot story—and provided many of the Bigfoot “experts” with an opportunity to claim their Warholian “fifteen minutes of fame” by testifying to the existence of the creature.

The two discoverers of the Georgia Bigfoot, Rick Dyer and Matthew Whitton, were soon celebrities, interviewed repeatedly on television and for stories posted on the Internet.² Searching for Bigfoot, Inc., a cryptozoological organization dedicated to proving that Bigfoot is real, paid them \$50,000 for their evidence. The head of the organization, Tom Biscardi, a long-controversial Bigfoot “hunter,”³ examined their find and endorsed it.⁴ Biscardi has his own radio show, which promotes paranormal ideas, and he interviewed Dyer and Whitton on the show. Finally, on August 15, Biscardi, Dyer, and Whitton held a press conference⁵ and displayed the body of Bigfoot for examination, frozen on blocks of ice.⁶ When the specimen was thawed, it turned out that the corpse was not real, but a rubber Sasquatch Halloween costume with

fake hair, padded and propped up to look like a Bigfoot. Dyer and Whitton soon admitted that their discovery had been a hoax all along, telling Atlanta's WSB-TV that they had "bought a costume off the Internet and filled it with possum roadkill and slaughterhouse leftovers."⁷

Once the deception was revealed, the story died in the mainstream media, but members of the community of Bigfoot "researchers" were at one another's throats over the debacle. Loren Coleman, a leading cryptozoologist, argued that Biscardi had been either in on the hoax or so anxious to find proof of his beliefs that he ignored the obvious evidence even when it was in front of him. "He's a huckster, a circus ringmaster," Coleman said.⁸ "It's all about money with him. It probably didn't matter to him whether it was real or not." Why would Dyer, a former security guard, and Whitton, a Clayton County police officer, pull the stunt in the first place? "They probably started out small, as a way to promote their Bigfoot tracking business, and got in way over their heads," Coleman said. "These are not very intelligent individuals." Of Biscardi and the "discoverers," Coleman commented, "In a way, both sides may have been trying to out-con each other." The Bigfoot Field Research Organization called for the arrest of the three principals in the fiasco. Whitton was fired from the police force for his part in the stunt.⁹

Most Bigfoot believers were angry that their work had been besmirched by a silly hoax, yet they continue to promote equally unlikely claims on a regular basis. Their gullibility should not be surprising: cryptozoology is built on openness to first-person testimony. More disturbing is the attitude of the mainstream media, which has long tended to approach "silly season" paranormal stories and monster yarns with a looser standard than that applied to other news items. That unfortunate double standard seems to be worsening, rather than improving. Would the Georgia Bigfoot—a story of questionable origin, with no independent sources to back it up—have made the evening news a generation ago, when there were only three networks and limited programming on television? Perhaps not. Those who remember the Watergate scandal and the book *All the President's Men* will recall that Bob Woodward and Carl Bernstein had to track down multiple reliable sources before publishing their allegations about the misdeeds in the White House. Today, the situation has changed: the modern television and Internet news are so hungry for anything to fill their airtime and Web space that they are much more likely to accept and report dubious stories from questionable sources without adequate (or in some cases, any) journalistic due diligence. With twenty-four-hour cable

television, such a story may run many times before anyone has a chance to check it. Even more to blame is the huge number of “documentaries” of pseudoscience on cable television, including those on stations that used to broadcast actual science documentaries. These stations promote pseudoscientific ideas just to draw audiences, earn high ratings, and justify their existence.

WHAT SCIENCE IS—AND IS NOT

Lost in the media firestorm generated by the Georgia Bigfoot stunt and in the huffing and puffing by the various pro-Bigfoot organizations was any scientific, critical perspective on the entire process. Almost all the “experts” who were interviewed about the hoax were committed believers in the reality of Bigfoot; their claims to “expertise” were that they had a Web site, wrote a book, or headed an organization dedicated to finding Bigfoot. Almost no actual biologists or other real scientists with relevant training were interviewed, and the story died so quickly that there was little commentary on it among scientists, even in the blogosphere. About the only exception was Thomas Nelson, a wildlife biologist and ecologist at North Georgia College and State University. With twenty years of experience in the area, he knows the wildlife of the “Bigfoot habitat” better than most. As he told local reporters, “Science is always open to new discoveries; however, the chances that a Bigfoot species exists anywhere in the world is highly unlikely. If Bigfoot inhabited North Georgia, people would have known about them long ago. Although the southern Appalachians might seem remote to some people, there are thousands of deer hunters, hikers, mushroom hunters, and campers using these forests throughout the year.”¹⁰ Nelson pointed out that there are legends of giants and monsters worldwide, but few of these stories have proved to be real. In particular, he pointed out that there are many possible sources of Bigfoot myths, including bears and vivid imaginations. “Or perhaps,” he said, “we just like to think that there are wild things in our world that are bigger and wilder than us. There is an upside to the media coverage, even if it did turn out to be a hoax. The coverage provided a ‘teachable moment’ to demonstrate to people how science works. We are open to new ideas, but skeptical until there is good supporting evidence—even of Bigfoot.”

Nelson raised an important point about the “teachable moment”: despite the gullibility of the media and the public, the Georgia Bigfoot hoax helps us think clearly about the scientific method. Science is about *testing hypotheses*,



Figure 1.1 A native black swan in Perth, Australia. (Photograph courtesy of Kylie Sturgess)

or offering ideas that may explain some facet of nature and seeing if they hold up to critical scrutiny. As philosopher Karl Popper pointed out, science is not about proving things true, but proving them false. You can make the general inductive statement “All swans are white,” but all the white swans in the world do not prove that the statement is true. One black swan easily falsifies the claim (figure 1.1). Scientists are open to any and every idea that can be proposed, no matter how crazy it may sound—but ultimately, for the idea to be accepted within the scientific community, it has to withstand the critical evaluation and peer-review process of the legions of scientists who are dedicated to shooting it down. Scientific hypotheses must always be tentative and subject to examination and modification, and they never reach the status of “final truth.”¹¹

Scientists are not inherently negative sourpusses who want to rain on everyone else’s parade. They are just cautious and skeptical about any idea that is proposed until it has survived the process of repeated testing and possible falsification and has come to be established or acceptable. They have good reason to be skeptical. Humans are capable of making all sorts of mistakes,

entertaining false ideas, and practicing self-deception. Scientists cannot afford to blindly accept an unsubstantiated claim by one person or even a group of people. They are obligated as scientists to criticize and carefully evaluate and test it before it is acceptable as a scientific idea.

This cautious approach is necessary in part because scientists are human and thus subject to the same foibles that all mortals are. They love to see their ideas confirmed and to believe that they are right. Yet in all sorts of ways, scientists can misinterpret or over-interpret data to fit their biases. As the Nobel Prize-winning physicist Richard Feynman put it, “The first principle is that you must not fool yourself—and you are the easiest person to fool.” That is why many scientific experiments are run by the double-blind method: not only do the subjects of the experiments not know what is in sample A or sample B, but neither do the investigators. They arrange to have the samples coded, and only after the experiment is run do they open the key to the code and learn whether the results agree with their expectations.

So if scientists are human and can make mistakes, why does science work so well? The answer is testability and peer review. Individuals may be blinded by their own biases, but once they present their ideas in a lecture or publication, their work is subject to intense scrutiny by the scientific community. If the results cannot be replicated by another group of scientists, then they have failed the test. As Feynman put it, “It doesn’t matter how beautiful your theory is, it doesn’t matter how smart you are. If it doesn’t agree with experiment, it’s wrong.”

This happens routinely in scientific research, although most people never hear about it because it is so common that it never catches the attention of the media. The media love to report on flashy ideas that have just been proposed, such as a meteorite impact causing a particular mass extinction, but soon move on to other glamorous topics and never report the debunking of the initial assertion a year or two later. The infamous case of “cold fusion” claimed by Stanley Pons and Martin Fleischmann in 1989 was a rare exception, since it was so astonishing that laboratories all over the world dropped everything and tried to replicate their results. The news media saw the story go from flashy proposal to discredited hypothesis in a matter of weeks. But whether it happens in weeks or years, scientists eventually test important ideas. Over enough time, most of the good ideas in science have been thoroughly vetted by this process and have passed from hypothesis or speculation to a well-established reality. As the late great astronomer Carl Sagan said in

his famous television show *Cosmos*, “There are many hypotheses in science which are wrong. That’s perfectly all right; they’re the aperture to finding out what’s right. Science is a self-correcting process. To be accepted, new ideas must survive the most rigorous standards of evidence and scrutiny.”

SCIENCE, BELIEF SYSTEMS, AND PSEUDOSCIENCE

The scientific method is often in direct conflict with many notions and beliefs that humans use to make decisions and guide their lives. Sometimes, a belief not only contradicts the discoveries of science and even common sense, but can harm the believers, as when members of snake-handling sects incorporate rattlesnakes and copperheads into their rituals in the belief that God will protect them—but nearly every member of such groups is bitten sooner or later, and more than seventy people have died over the past eighty years. Adherents of some religions and even the recent rash of vaccination deniers refuse to accept the advantages of modern medicine, even though the evidence is overwhelming that vaccines are a safe and effective means to protect themselves and their children from the risk of serious illness (or even death). As Sagan put it, “If you want to save your child from polio, you can pray or you can inoculate.”¹²

Many nonscientific belief systems try to sound “scientific,” even though their ideas and methods do not correspond to those of science. They try to appropriate the respectability of science—science has done so much for our civilization and is held in high regard by many people—without actually doing science. They include such decidedly nonscientific belief systems as Christian Science (which actually rejects modern medicine) and Scientology, as well as the attempts by Christian fundamentalists to frame their biblical ideas as scientific creationism or creation science. But if their ideas were examined by strict scientific methods, they would fail the test; because their tenets cannot be falsified in the minds of their followers, they have nothing to do with real science.

The creationists, in particular, are tireless in their attempts at subterfuge. They first went by the relatively honest label “biblical creationism” until the federal courts threw out their efforts to include creationism in public-school science curricula because it would be a violation of the First Amendment principle of separation of church and state. So in the late 1960s, they simply renamed themselves scientific creationists and deleted the overt references to God in their textbooks. But it is clear from their documents that scientific

creationism is simply old-fashioned biblical creationism without the obvious religious terminology. Even more revealing, creationists in many organizations must swear to an oath of literal acceptance of the Bible, and any scientific ideas they propose must be bent to conform to their version of Genesis. This is hardly the practice of real scientists, whose conclusions must be tentative and always subject to rejection and falsification. A series of federal court decisions saw through this creationist sham, so since the 1980s the creationists have tried to sneak their religious ideas into public schools by increasingly subtle methods. For about a decade, they used the ruse of intelligent design until they were shot down in December 2005 by a court decision in Dover, Pennsylvania. Now intelligent design is on the decline, no longer pushed on school districts. Currently, the creationists are using even sneakier tactics: “teach the controversy,” “teach the strengths and weaknesses of evolution,” and the like. But they always leave a paper trail. If you track down who sponsored the idea and what they have revealed about their religious motivations, it always boils down to yet another attempt to conceal their religious motivation. Once it reaches the court system, this newest attempt to insinuate an anti-evolution agenda into public schools will be rejected.

“BALONEY DETECTION” AND PSEUDOSCIENCE

The practice of making claims that appear to be scientific, but do not actually follow the scientific method of testability and falsification of hypotheses, is usually called *pseudoscience*. There are many kinds of pseudoscience—trying to give us (or sell us) answers to questions that we want answered or attempting to appeal to our sense of wonder and mystery—but all fail the criteria of science: testability, falsifiability, peer review, and rejection of ideas when they do not pan out. Most educated people have developed a sense of skepticism when it comes to everyday claims, like the lies, half-truths, and exaggerations that we hear in sales pitches, see in commercials, and read in advertisements. Our “baloney detection kit” (as Carl Sagan put it) is good at filtering out these assertions, and in most practical aspects of our lives we follow the maxim “caveat emptor” (let the buyer beware). Yet we ignore these filters when something promises to give us comfort or help with uncertainty. When a psychic claims to be able to communicate with our dead relatives, a snake-oil salesman or faith healer offers us phony cures for our ailments, or an astrologer or a fortune-teller professes to be able to forecast our future, they are preying on our vulnerability.

Even though Americans have one of the highest standards of living in the world, and one of the best educational systems, we are as gullible as ever. Poll after poll shows that high percentages of Americans believe in demonstrably false or pseudoscientific ideas—from UFOs to extrasensory perception (ESP), astrology, tarot cards, palm reading, and so on. It does not seem to matter that these notions have been repeatedly debunked. As *Skeptic* magazine publisher Michael Shermer points out, people have a *need* to believe in such things, since they provide comfort or help cope with the uncertainties of the future.¹³ We can all sympathize to some degree with how people might find reassurance in the predictions made by a fortune-teller or solace in the communiqués from the other world transmitted by a psychic. But it is puzzling that so many people believe in UFOs or give any credence to the vile and scary anti-Semitism of Holocaust deniers.

A number of general tools can be used to detect “baloney.” Most of them were offered by Shermer and Sagan,¹⁴ but this list will focus on those directly relevant to the subject of this book.

- *Extraordinary claims require extraordinary evidence:* This famous statement by Carl Sagan (based on Marcello Truzzi’s maxim “An extraordinary claim requires extraordinary proof”) is the most important to the subject of cryptozoology.¹⁵ As Sagan noted, hundreds of routine discoveries and assertions are made by scientists nearly every day, but most are just small extensions of what is already known and do not require thorough testing by the scientific community. But it is typical of crackpots, fringe scientists, and pseudoscientists to make revolutionary pronouncements about the world and argue strenuously that they are right. For such claims, it is not sufficient to have just one or two suggestive pieces of evidence—such as blurry photographs, eyewitness accounts, and ambiguous footprints of, say, Bigfoot—when most of the proof goes against cherished hypotheses. Extraordinary evidence, such as the actual bones or even the corpse of the creature, is required to overcome the high probability that it does not exist.
- *Burden of proof:* In a criminal court, the prosecution must prove its case beyond a reasonable doubt, and the defense need do nothing if the prosecution fails to do so. In a civil court, the plaintiff has to prove its case based on a preponderance of the evidence, and the respondent need do nothing. In science, extraordinary claims have a higher burden of proof than do routine scientific advances because they aim to overthrow a large-

er body of knowledge. When evolution by means of natural selection was first proposed 150 years ago, it had the burden of proof because it sought to overturn the established body of creationist thought. Since then, so much evidence has accumulated to show that evolution has occurred that the burden of proof is back with the creationists, who seek to overthrow evolutionary biology. And the burden of proof lies with those who believe in the existence of most of the cryptids discussed in this book, since so much of what is claimed about them goes against everything we know from biology, geology, and other sciences.

- *Authority, credentials, and expertise:* One of the main strategies of pseudoscientists is to cite the credentials of the leading proponents of their claims as proof that they are credible. But a doctoral degree or advanced training is not enough; the “authority” must have advanced training in the *relevant fields*. Pointing to an advanced degree is a strategy to intimidate the members of an audience into believing that the holder of the degree is smarter than they are and an expert in everything. But those who have earned a doctorate know that it qualifies the holder to talk about only the field of her training, and during the long hard slog to get a dissertation project finished and written up, a doctoral candidate actually tends to *lose* some of his or her breadth of training in other subjects. Most scientists agree that anyone who is flaunting a doctoral degree while making his arguments is “credential mongering.” A good rule of thumb: if a book says “Ph.D.” on the cover, its arguments probably cannot stand on their own merits.

Creationists do this all the time by pointing to lists of “scientists who do not accept evolution.” Those on the list, though, have degrees that are irrelevant to the fields they are critiquing: they often have degrees in engineering, hydrodynamics, physics, chemistry, mathematics, veterinary medicine, dentistry, and perhaps biochemistry. But among them are vanishingly few paleontologists or geologists and almost no biologists trained at major institutions. The absurdity of this strategy, which also is used by those who deny the reality of global warming, was revealed by the National Center for Science Education (NCSE), which fights creationist attacks on public-school science curricula. Rather than try to compile a list of the 99.99 percent of qualified scientists who *do* accept the reality of evolution (compared with the creationist list of a few dozen), the NCSE organized Project Steve.¹⁶ This list consists of just scientists whose name is Steve (or Steven, Stephen,

Stefan, or Stephanie) and who accept evolution, which would make up less than 1 percent of all scientists who accept evolution—and it is much longer than the creationists’ total list, with more than 1,200 names so far!

The same can be said for proponents of cryptozoology. Few of those who promote cryptozoology or engage in cryptozoological research—including those on a “hall of fame” list of famous cryptozoologists¹⁷—have advanced degrees or relevant training in fields that could make them authorities in finding or documenting mysterious beasts. These fields include wildlife biology and ecology, systematic biology, paleontology, and physical anthropology. Most monster hunters are amateur enthusiasts who are not familiar with the rules of science and are not trained in the basics of ecology, paleontology, or field biology. Others boast impressive-sounding titles such as “zoologist” or “Dr.” while important clarifying information is omitted. For example, the late Richard Greenwell, a co-founder and long-time secretary of the defunct International Society of Cryptozoology (ISC) who collaborated on Roy Mackal’s cryptozoological expeditions, has been referred to as “Dr.” by Bigfoot proponent John Bindernagel and others.¹⁸ However, Greenwell had no formal training in relevant fields; his “doctorate” was an honorary degree from the University of Guadalajara in Mexico.¹⁹ Similarly, William Gibbons, a champion of Mokele Mbembe, sometimes is described by cryptozoological sources as “Dr. Bill Gibbons” and boasts several degrees.²⁰ Gibbons’s bachelor’s and master’s degrees in religious education were granted by a religious institution, however, and have no academic standing,²¹ while his doctorate in cultural anthropology was procured from Warnborough College, Oxford—an institution not associated with Oxford University that has been determined (and fined) by the Department of Education to be unauthorized to grant degrees in Great Britain, and therefore not eligible to participate in federal student financial assistance programs in the United States.²² (If the Oxford location makes Warnborough sound more impressive than it is, this is unlikely to be accidental. As the *New York Times* explained, “Officials at Oxford University say that Warnborough is only the latest and most shameless in a string of institutions that unfairly trade on Oxford’s name and reputation abroad,” with students alleging that they had been misled into the false belief that Warnborough was formally associated with Oxford University.)²³

There are exceptions to the generalization that cryptozoologists lack advanced degrees in relevant fields (some of which we will discuss in chap-

ter 7), but even these exceptions may be more complicated than they appear. Some, like Ben Speers-Roesch, got hooked on cryptozoology as teenagers but became critics of cryptozoological research as their scientific training advanced (and as their familiarity with cryptozoology's shortcomings deepened).²⁴ Others, like paleozoologist Darren Naish, are friendly to cryptozoology in principle, yet highly critical of its claims in practice.²⁵ Among those more wholeheartedly supportive of cryptozoology, Roy Mackal (another co-founder of the ISC) is frequently cited as a legitimate scientist with a doctorate in biology. This is true: he is retired from the University of Chicago, where from the late 1950s to the late 1960s he did highly respectable research in molecular biology and microbiology. Mackal's later research and writing related to the search for the Loch Ness monster and the alleged Congo dinosaur, Mokele Mbembe, however, displaced his mainstream scientific work—and had no close connection to his area of scientific expertise. Notably, Mackal has no credentials in field biology, paleontology, or ecology. Stronger exceptions include wildlife biologist John Bindernagel and anatomist Jeffrey Meldrum, both of whom are leading proponents of Bigfoot whose formal training is relevant to their area of cryptozoological focus. But the interest of a handful of formally trained authorities tells us little about the robustness of the evidence for Bigfoot (or any cryptid). Thousands of similarly trained anthropologists are just as qualified to examine and critique the evidence for Bigfoot, and they are virtually unanimous in considering the evidence for Bigfoot to be useless or marginal at best.²⁶ This is the process of peer review at work. Even if someone does have proper training, what he or she thinks is not necessarily true or authoritative. The ideas must pass muster in the process of peer review, and he or she must defend the evidence for the rest of the scientific community to take the claims seriously.

- *Special pleading and ad hoc hypotheses:* One of the marks of pseudoscientists is that when the evidence is strongly against them, they do not accept the scientific method and abandon their cherished hypotheses. Instead, they resort to special pleading to salvage their original ideas, rather than admitting that they are wrong. Such attempts are known as ad hoc (for this purpose) hypotheses and are universally regarded as signs of failure. When a psychic conducts a séance and does not contact the dead, she may plead that the skeptic “just didn’t believe hard enough” or the “room wasn’t dark

enough” or the “spirits didn’t feel like coming out this time.” When a creationist is told that Noah’s Ark could not have housed the tens of millions of species of animals, he may use an evasion like “only the created kinds were on board” or “fish and insects don’t count” or “it was a miracle.” Science, however, does not permit such creative, convenient flexibility; ideas in science must stand or fall according to the evidence. This is, as the great Victorian naturalist Thomas Henry Huxley said, “The great tragedy of Science—the slaying of a beautiful hypothesis by an ugly fact.”²⁷

EYEWITNESS TESTIMONY: INSUFFICIENT EVIDENCE

Humans are storytelling animals, and they are easily persuaded by the testimony of other individuals. Telemarketers and advertisers know that if they get a popular celebrity to endorse a product, it will sell briskly, even if no careful scientific studies or Food and Drug Administration approvals back up their claims. The endorsement of your next-door neighbor may be good enough to make simple decisions, but anecdotal evidence counts for very little in science. As celebrated science historian Frank Sulloway put it, “Anecdotes do not make a science. Ten anecdotes are no better than one, and a hundred anecdotes are no better than ten.”²⁸

Most scientific studies require dozens to hundreds of experiments or cases, and detailed statistical analyses, before scientists can tentatively accept the conclusion that event A probably caused event B. In the testing of medicines, for example, there must be a control group, which receives a placebo rather than the treatment under study, so the experimenters can rule out the possible influence of the power of suggestion as well as random effects. Only after such rigorous testing—which can eliminate the biases of the subjects and the observers, random noise, and all other uncontrolled variables—can scientists make the statement that event A *probably caused* event B. Even then, scientists do not speak in finalistic terms of “cause and effect,” but only in probabilistic terms that “event A has a 95 percent probability of having caused event B.” Independent replication by other scientists helps to refine the findings—but no conclusion, no matter how often or robustly confirmed, is ever wholly free from uncertainty.

If scientists are obligated to consider the outcomes of the most tightly controlled laboratory experiments to be tentative, they must naturally approach eyewitness testimony with even greater caution. Eyewitnesses may

have some value in a court of law, but their anecdotal evidence is necessarily regarded as highly suspect in most scientific studies. Thousands of experiments have shown that eyewitnesses are easily fooled by distractions such as a weapon, are confused by stress, or otherwise are misled into confidently “remembering” events that did not happen.²⁹ The extreme fallibility of eyewitness testimony was vividly demonstrated in a famous psychology experiment, conducted in 1999, in which subjects were instructed to watch a video and count the number of times young men and women dressed in white pass a basketball.³⁰ During the video, a person in a gorilla suit barges into the center of the scene, looks straight into the camera, lingers to pound his chest, and then strolls out of the scene. However, roughly half of first-time viewers are shocked to learn that they overlooked the gorilla entirely! With their attention focused on counting the passes, a majority of people are unable to correctly perceive what happens right in front of their eyes.

The “inattentional blindness” effect, which renders the gorilla invisible, is just one of many ways in which eyewitness perception may critically fail. As A. Leo Levin and Harold Kramer put it, “Eyewitness testimony is, at best, evidence of what the witness believes to have occurred. It may or may not tell what actually happened. The familiar problems of perception, of gauging time, speed, height, weight, of accurate identification of persons accused of crime all contribute to making honest testimony something less than completely credible.”³¹ Consequently, court systems around the world are undergoing reform as DNA evidence has revealed case after case of eyewitness testimony that resulted in a wrongful conviction. As psychologist Elizabeth Loftus has shown, eyewitness accounts of events and their memory of them are notoriously unreliable:

Memory is imperfect. This is because we often do not see things accurately in the first place. But even if we take in a reasonably accurate picture of some experience, it does not necessarily stay perfectly intact in memory. Another force is at work. The memory traces can actually undergo distortion. With the passage of time, with proper motivation, with the introduction of special kinds of interfering facts, the memory traces seem sometimes to change or become transformed. These distortions can be quite frightening, for they can cause us to have memories of things that never happened. Even in the most intelligent among us is memory thus malleable.³²

Skeptical investigators Benjamin Radford and Joe Nickell recount several examples that make this point vividly.³³ In 2004, Dennis Plucknett and his

fourteen-year-old son, Alex, were hunting in northern Florida. Alex was in a ditch some 225 yards away from his father when someone yelled “Hog!” Dennis grabbed his gun, pointed it at a distant moving object that looked like a wild hog to him, and fired. Instead, he killed his son with a single shot to the head. Alex had been wearing a black toboggan cap, not a hog costume or anything else that would have made him look remotely hog-like. Yet at that distance, and with the suggestion that a wild hog was nearby, Dennis mistook a toboggan cap for a boar, and a tragic result occurred. Indeed, hunting accidents like this are common, since many hunters shoot first and ask questions later, often confused by distant objects that are moving and by the suggestibility of their own imaginations to “see” what they are looking for—not what is really there.

Or take the Washington, D.C., sniper panic of 2002. Early eyewitnesses told the police to look for a white or light-colored box truck or van, with a roof rack. Police officers wasted weeks of time and caused huge traffic jams stopping every vehicle that remotely matched the description. Finally, the suspects, John Lee Malvo and John Allen Muhammad, were caught—and the white van turned out to be a dark blue sedan. Police chief Charles H. Ramsey said, “We were looking for a white van with white people, and we ended up with a blue car with black people.”³⁴ Newspapers reported that the suspects had actually been stopped several times during the period of the panic because they were near the site of one of the attacks, but each time they were released because their car did not match the descriptions.³⁵

Some “memories” of strange experiences or eyewitness accounts of bizarre beasts can be attributed to sleep deprivation, dreams, and hallucinations. For example, Michael Shermer has described how he had an experience of being abducted by aliens in 1993.³⁶ At the time, he was undergoing the stress of competing in an ultra-marathon cross-country bicycle race; badly exhausted, his brain misperceived his own support crew as space invaders and their motor home as an alien spacecraft. As he showed, some famous accounts of alien abductions and out-of-body experiences may be attributable to dreams or hallucinations caused by stress.³⁷ Harvard psychologist Susan Clancy’s research on alien abductees expanded on this, revealing that the seed for abduction beliefs need not be as literal as Shermer’s hallucination. As she explained, “Coming to believe you’ve been abducted by aliens is part of an attribution process. Alien-abduction beliefs reflect attempts to explain odd, unusual, and perplexing experiences.”³⁸ These anomalous experiences include common sleep disruptions, such as sleep paralysis (a viscerally com-

elling experience that occurs at the transition between wakefulness and sleep, often combining physical paralysis with hallucinations). Seeking an explanation, people find that alien abduction is one of the culturally available scripts for mysterious happenings—and once that seed is planted, it tends to grow. “Once abductees have embraced the abduction theory, everything else tends to fall into place,” cautioned Clancy. “Alien abduction easily accommodates a great variety of unpleasant symptoms and experiences.” Memories are malleable; over time, they may change to better match the abduction narrative. Similar processes distort the cryptozoological literature—and indeed, distort all literature that involves testimonials. Whether “eyewitness” accounts describe cryptids, ghosts, aliens, or muggers, it is an inconvenient fact of human nature that individuals quite commonly imagine things that are not really there, misinterpret known phenomena (such as sleep paralysis, bears, or the planet Venus), and, in an attempt to understand their experience, rely on memories that may include false details.

Scientific investigators must also tread carefully with indigenous, developing societies. Unlike highly industrialized culture, which has very specific ideas of what is reality and what is myth, native cultures can be much less rigid and literal. Thus when investigators go to a remote region and inquire about a legendary animal, such as the Yeti, they cannot determine whether the animal is literally or mythically real. Even worse are attempts to elicit responses by showing photographs or drawing sketches of the animal being sought or, in especially egregious instances, first providing a story and then demanding that local informants confirm it.³⁹ In a court of law, that is considered leading the witness and it is not allowed, since this practice often biases the testimony or plants a suggestion in the mind of the witness. Thus “witnesses” may claim to have seen any animal that remotely resembles that being sought.

What is the proper scientific approach to eyewitness testimony? As we have seen, most scientists give it very little weight unless there is strong physical evidence to support it. Even the most reliable eyewitness account does not meet the standard of “extraordinary evidence” that is necessary to substantiate an “extraordinary claim.”

WHAT IS A CRYPTID? PERSPECTIVES FROM REAL SCIENCE

The term “cryptozoology” comes from the Greek words *kryptos* (hidden) and *zoos* (life) and literally means “the study of hidden animals.” The origins of this and related terms (such as “cryptid” and “cryptozoological”) are some-

what unclear and thus a matter for much discussion.⁴⁰ The word “cryptozoology” is often traced to Lucien Blancou, who in 1959 dedicated a book to Belgian zoologist Bernard Heuvelmans as the “master of cryptozoology,” in honor of Heuvelmans’s book *On the Track of Unknown Animals*, published in French four years earlier.⁴¹ Because of his reputation as an early major figure in the field, Heuvelmans is sometimes thought to have coined the term “cryptozoology” himself. But Heuvelmans gave the credit to Scottish explorer Ivan T. Sanderson: “When he was still a student he invented the word ‘cryptozoology,’ or the science of hidden animals, which I was to coin much later, quite unaware that he had already done so.”⁴² As early as 1941, a reviewer of Willy Ley’s *The Lungfish and the Unicorn* described it as covering “not only lungfish and unicorns but an array of other marvels, zoological and cryptozoological, from the *mushrush* of the Ishtar Gate to the basilisk, the tatzelwurm, the sea serpent, and the dodo.”⁴³ In any event, the discipline that we now call cryptozoology goes back much further—certainly to Anthonie Cornelis Oudemans and his book *The Great Sea-serpent* (and arguably back to Pliny the Elder and other natural historians of classical antiquity, as we will see in chapter 5).⁴⁴

By most definitions, any purposeful search for unconfirmed animals (or unconfirmed populations of animals) can be classified as cryptozoology, although conventionally the focus is entirely on hypothetical animals of spectacular size, such as Bigfoot, Nessie, and Yeti. The term “cryptid” was coined by John Wall to refer to the animals that are sought by cryptozoologists.⁴⁵ As Darren Naish has pointed out,⁴⁶ the definition of cryptids is highly fluid. Heuvelmans wrote that in order to be considered a cryptid, a creature must be “truly singular, unexpected, paradoxical, striking, or emotionally upsetting.” He argued that these characteristics allow such an animal to become the subject of myths and thence *become* a cryptid.⁴⁷ Yet Heuvelmans’s list of animals that he thought might soon be discovered includes such cryptids as a marmot-size mammal from Ethiopia, a small wildcat from the Mediterranean, and a flightless rail from the South Pacific—creatures that would not astound most zoologists if they were indeed found.⁴⁸ Naish redefined “cryptozoology” to refer to the study of animals known only from *indirect evidence*: eyewitness accounts and anecdotal clues, such as sightings, photographs, stories, casts of footprints, and questionable hair or tissue samples. This definition distinguishes cryptids from animals whose existence is based on the *direct evidence* of actual specimens that have been captured or bones that have been collected.

The distinction between cryptozoology and conventional biology is not necessarily very big. As Naish points out, several hundred previously



Figure 1.2

A mountain gorilla in Bwindi Impenetrable Forest, Uganda. (Photograph by Julie Roberts)

unknown species are discovered and described every year,⁴⁹ although most are insects and other invertebrates that do not capture the imagination of nonscientists. Nor it is unusual for a creature to be known from folk legend before scientists officially “discover” it. A number of these “former cryptids” are suggested by cryptozoology advocates as evidence that many animals are yet to be found. The “former cryptids” include the lowland gorilla, known from legend since the seventeenth century but not described until 1840, and the mountain gorilla, not described until 1901 (figure 1.2). The okapi, the only close living relative of the giraffe, was well hidden in the dense jungles of Central Africa and known to the local peoples before it was officially “discovered” in 1901 (figure 1.3). The Komodo dragon was called the “land crocodile” by Indonesians and frequently reported since 1840, but was not officially named or described until 1912. The kouprey, a large ox native to the jungles of Cambodia, was first mentioned in 1860, but not officially named until 1937.

Although the rate of discovery of large animals has dropped off considerably in the past century, less spectacular species are found every year. Naish summarizes a considerable catalogue of them.⁵⁰ They include a number of species of small brocket deer, from Central and South America, and muntjacs, from Southeast Asia, described in the past decade, as well as tree kangaroos and numerous primates, rodents, and bats. Among animals known from



Figure 1.3

The okapi, an animal native to the Democratic Republic of the Congo, was long rumored on the basis of testimony from local informants before it was formally identified for science in 1901. (Illustration by Daniel Loxton)

native accounts is the kipunji, a Tanzanian monkey, which was described in 2005. The odedi, a bush warbler from Bougainville Island in the South Pacific, was formally described in 2006. In 2008, zoologist Marc van Roosmalen claimed to have discovered a dwarf species of manatee in the Amazon River, although the DNA evidence has so far failed to show that it is really distinct from the large Amazonian manatee, and this “species” may be based on immature specimens.

Some “new” species were first known from fossils and then discovered alive. The classic example is the Chacoan peccary, a relative of the peccaries or javelinas, which are widespread across the southwestern United States, Central America, and South America. First described from a tooth fossil by the famous Argentine paleontologist Florentino Ameghino in 1904, it was known to natives of the Gran Chaco in Paraguay for decades before scientists “discovered” it and named it.⁵¹ Van Roosmalen recently claimed to have found a fourth species, the “giant peccary” of the Brazilian Amazon basin, although it has not yet been accepted as distinct by most other zoologists.

The most famous example of a creature known first from fossils is the coelacanth, a lobe-finned fish related to lungfishes and amphibians (figure 1.4). Before 1938, it was known primarily from rare fossil specimens older than 65 million years and was thought to be extinct. (There are now fossils as young

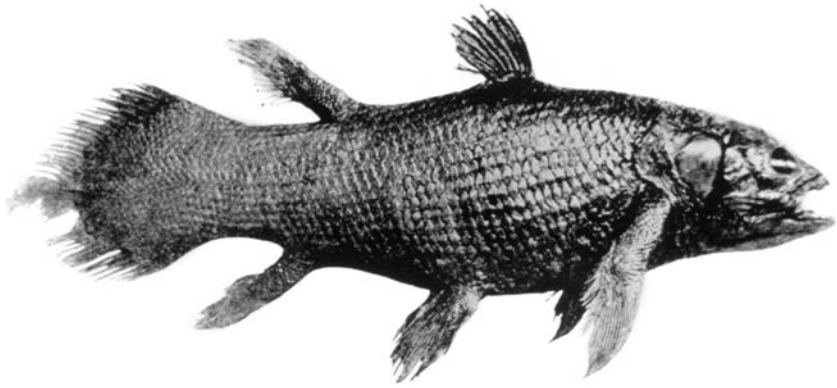


Figure 1.4 The West Indian Ocean coelacanth (*Latimeria chalumnae*), a “living fossil,” was known originally from fossils older than 65 million years old until a live fish was caught off South Africa in 1938. It has now been found in several places around the Indian Ocean, including off the coasts of Indonesia and the Comoros Islands. (Reproduced by permission of Fortean Picture Library, Ruthin, Wales)

as 15 to 5 million years old, so the gap is no longer as great as it once was.)⁵² Then in 1938, a living coelacanth was found in a deep-water trawl off the coast of South Africa and was immediately recognized as a relict of the early evolution of fishes. Its great significance led to a widespread hunt for more specimens and a sizable cash reward, and eventually more coelacanths were discovered off the Comoros Islands north of Madagascar and, more recently, off the coast of Indonesia and again off South Africa. The oceans continue to reveal many new and spectacular fishes—such as the megamouth shark discovered in 1976—squids, and other creatures, so the pace of discovery is no less impressive than that for land animals. The remotest and deepest parts of the seas still may hold secrets as yet undreamed of.

REALITY CHECKS

Biology and Ecology

If so many animals are still being found every year, why is the study of Bigfoot and Nessie considered “fringe science”? There are important distinctions to make between animals newly known to science and cryptids, even when the folkloric elements are set aside. Nearly all the “new” species just mentioned are relatively small in body size and are closely related to other living

animals—so it was easy to mistake them for familiar species until more detailed studies could be undertaken—and none are outside the normal range of zoological diversity. The last large land animals to be found and named by biologists were the Chacoan peccary, lowland and mountain gorilla, okapi, Komodo dragon, and kouprey, and all were described about 50 to 150 years ago. In addition, nearly all these discoveries were made in remote areas of Africa, Indonesia, and Southeast Asia, *not* in well-populated places like Scotland and the Pacific Northwest (where Nessie and Bigfoot allegedly reside).

Biologists have dealt rigorously with the question of how many species remain to be found, using a variety of sophisticated methods to model “discovery curves” (figure 1.5). Applying these techniques in 2008 to a question of interest to cryptozoologists, Michael Woodley, Darren Naish, and Hugh Shanahan estimated that as many as fifteen species of seals and sea lions (pinnipeds) conceivably remain undiscovered, although they warned that this figure was “probably a significant over-estimate of the true number likely to exist.” Turning to a slightly different estimation technique, they suggested that few or no species of pinniped are yet to be found.⁵³ Naish expanded,

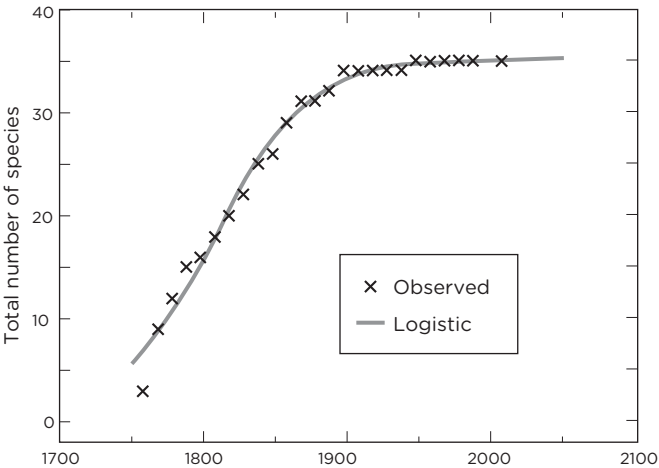


Figure 1.5 A curve showing the number of new species of pinniped discovered over the past 300 years, with observed data shown by the x and a logistic curve fit in the solid line. The curve indicates that discoveries of unknown species of marine animals such as pinnipeds have reached a point of diminishing returns, so there are few or no species remaining to be found. (Modified from Michael A. Woodley, Darren Naish, and Hugh P. Shanahan, “How Many Extant Pinniped Species Remain to Be Described?” *Historical Biology* 20 [2008]: 225–235)

“We definitely favoured the idea that there are hardly any new pinnipeds to find—that is, there are about zero new ones out there, with one or two being conceivable based on the data. This could be taken to mean that cryptozoological ideas of new pinnipeds are unlikely, since there probably aren’t many (or any) new pinnipeds to find. *Or*, it could be taken as being consistent with cryptozoological ideas about crypto-pinnipeds”—provided that only a very small number of cryptozoological pinnipeds are proposed.⁵⁴ When we add to this reality check the constraining factors that seals are noisy and return often to land in order to molt and breed (where they would presumably be seen and identified), we may conclude that reports of “sea monster” cryptids are highly unlikely to be of genuine sightings of as-yet-undiscovered species of seals (despite the popularity of the “pinniped hypothesis” in the cryptozoological literature) but more likely are cases of mistaken identity. Andrew Solow and Woollcott Smith took an even broader approach and showed that the discovery rate of large marine animals has dropped dramatically in the past few decades. From this method, they estimated that, at best, fewer than ten species of large marine animals remain to be found.⁵⁵

Thus the discoveries of the okapi and the kouprey do not really help the cause of cryptozoologists because these animals are within the realm of conventional zoology. These were zoological discoveries of the type that we would expect once qualified field zoologists began to work in remote and sparsely populated areas like tropical Africa and Southeast Asia. Similarly, the discoveries of the coelacanth and the megamouth shark may be remarkable, but these fish dwell in very deep, seldom fished waters in only a few places on Earth. It is easier for animals to remain hidden for a longer period in poorly accessible locations—and yet, notably, animals such as the okapi and coelacanth eventually were located and described.

By contrast, hundreds of zoologists and tens of thousands of hikers, campers, and loggers wander the woods of the Pacific Northwest, yet not one has managed to find any hard evidence to support the existence of Bigfoot. Nearly all the “evidence” consists of anecdotes and eyewitness accounts, dubious film footage, and a spectrum of suspicious footprint casts, plus hair of undetermined origin. The forests of the Pacific Northwest are neither remote nor underexplored; indeed, they have been decimated by clear-cut logging (and more recently, by the mountain pine beetle epidemic).⁵⁶ Every animal that lives in these forests leaves plenty of hard evidence of their existence: nests and dens, carcasses, skeletons and partial skeletons, teeth, and isolated individual bones. Yet not once has the elusive Bigfoot left so much as a single toe bone, and ex-

planations from advocates that Bigfoots somehow decay faster than other animals or are buried by their kin are ad hoc and simply do not cut it.

This raises an even more important issue: animals the size of Bigfoot, Nessie, and Yeti cannot simply be singletons or the last surviving lonely members of their species. If they have persisted through thousands of years and been sighted hundreds of times, as their advocates claim, they must have significant populations. If they are living as viable populations, there should be hundreds of reliable sightings, many good examples of film footage, and plenty of hard evidence in the form of carcasses and bones—not only of isolated individuals, but of groups, including females and their young. Ironically, the best proof that these cryptids do not exist comes *not* from the abundance of questionable evidence that cryptozoologists try to promote, but from the dearth of *more* quality evidence, especially conclusive, concrete proof in the form of carcasses and bones.

Even more interesting is that as more and more people have been looking for these creatures in the woods of the Pacific Northwest, the snows of the Himalayas, the jungles of the Congo, and the waters of Loch Ness, the evidence for the existence of Bigfoot, Yeti, Mokele Mbembe, and Nessie has *diminished*, not increased. In the modern world, where cell-phone cameras are ubiquitous and space satellites that can read newspapers on Earth are constantly watching us, the absence of reliable images does not bode well for the existence of cryptids.

The next important consideration is that populations of cryptids as large in body size as Bigfoot, Yeti, and Nessie would have to occupy relatively extensive areas to obtain enough food and other resources to sustain themselves. Although the relationship between body size and home range is complicated, in general home range expands as body size increases, as is confirmed by the large and complex literature on the relationship of home range and body size (figure 1.6).⁵⁷ As Johan du Toit has shown,⁵⁸ for large-bodied African mammals, the home range (A_{hr}) scales by body mass (M) in the formula

$$A_{hr} = 0.024 M^{1.38}$$

Lowland gorillas have home ranges of roughly 40 square miles, and they are much less active and mobile than, say, giraffes (which require individual ranges of about 110 square miles). Animals the size of the presumed wide-ranging bipedal Bigfoot and Yeti would have to occupy home ranges of at least 100 square miles. But because so much of this habitat has been degraded or broken up by human habitation, they would be forced onto

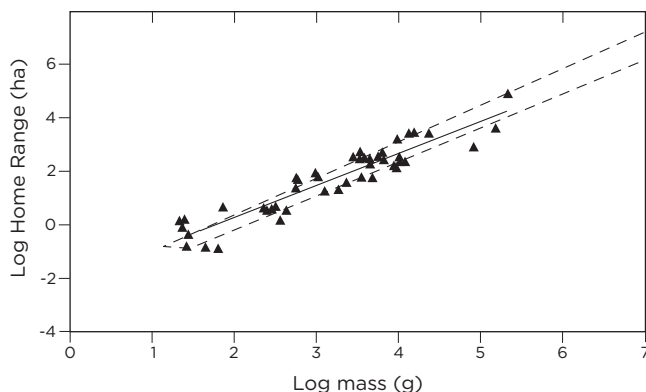


Figure 1.6 A plot of body mass versus home-range area for omnivorous land animals, showing that animals of very large body size (such as Bigfoot, the Yeti, and Mokele Mbembe) require huge home ranges in order to sustain a viable population. A similar plot applies to herbivores and carnivores as well. (Data replotted from Douglas A. Kelt and Dirk H. Van Vuren, "The Ecology and Macroecology of Mammalian Home Range Area," *American Naturalist* 157 [2001]: 637-645)

remnant patches, enhancing the likelihood of their discovery or, conversely, decreasing the likelihood of their existing.

This is the problem that large animals face in places like the tropical rain forest. In a famous monograph, ecologists Robert MacArthur and Edward O. Wilson showed that the number of species in a given region is well predicted by the total area that they occupy.⁵⁹ Using this famous relationship, rain-forest ecologists have found that breaking the forest into numerous small patches separated by logged or farmed areas leads to the disappearance of large animals, since jaguars, tapirs, rhinos, and tigers need huge home ranges in order to survive. This problem would be magnified in the case of Bigfoot, whose temperate-forest habitat has been chopped into hundreds of small preserves and parks, separated by roads and towns and farms. Even within the larger national forests, most of the pristine regions are extremely reduced or have been destroyed because of clear-cut logging.

Limited range is an even bigger problem for Nessie and the wide assortment of air-breathing "lake monsters" that have been promoted as cryptids. Loch Ness and other lakes said to be the home to monsters are relatively small bodies of water that are generally not rich enough in fish and other food resources to sustain a population of the enormous creatures purported to live in them.

Geology

If the problems enumerated by ecology were not enough to reduce the plausibility of the existence of large cryptids, there are even bigger hindrances apparent to a geologist. Let's start with a very simple constraint: the Ice Age of the Pleistocene epoch (2.5 million–11,700 years ago). As recently as 20,000 years ago, the northern part of the Northern Hemisphere was covered by a sheet of ice more than 1 mile thick, similar to the ice sheets that now cover Greenland and Antarctica (figure 1.7). Thus Loch Ness (and much of the British Isles, except for the southern margin during interglacial warmings) was under a glacier for most of the past 3 million years. Either the Nessie population was frozen in the ice and then miraculously was resuscitated after thawing (a biological impossibility), or the creatures lived elsewhere and swam

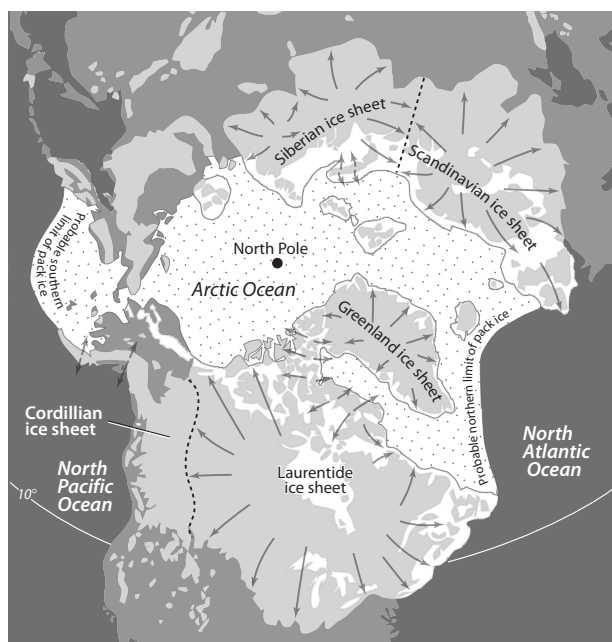


Figure 1.7 During the Ice Age of the Pleistocene, sheets of ice covered not only the polar regions, but most of northern Eurasia and North America, including all the lakes (such as Loch Ness and Lake Champlain) that allegedly are home to monsters. Thus if such creatures existed at that time, they either were frozen under a mile of ice or somehow swam into these landlocked lakes from the distant North Sea and Atlantic Ocean. (From Donald R. Prothero and Robert H. Dott Jr., *Evolution of the Earth*, 8th ed. [Dubuque, Iowa: McGraw-Hill, 2010])

into Loch Ness. Yet Loch Ness is a freshwater lake 52 feet above sea level. If Nessie were indeed an ocean-going plesiosaur, why have plesiosaurs not colonized other freshwater rivers and lakes—and where are the other saltwater plesiosaurs today? Glaciation is an even more serious problem for inland cryptids like Champ, which supposedly lives in a lake that is far inland, a long way from the nearest outlet to the Atlantic Ocean—and Lake Champlain, the home of Champ, was buried under even more ice than was Loch Ness just 20,000 years ago. Indeed, most of the lakes that allegedly support cryptids are in northern regions and were buried under ice during the last glaciation.

Paleontology

Even more problematic is the evidence—or lack of evidence—from the fossil record. No one claims that the fossil record is perfect, but paleontologists have an excellent understanding of which organisms tend to fossilize well and which ones do not.⁶⁰ Small animals with delicate bones (like birds) may be underrepresented in the fossil record, but large animals with robust bones (like large nonavian dinosaurs) have a much better chance of being preserved. An excellent fossil record exists for such large animals as mammoths, mastodons, rhinos, and dinosaurs. For this reason, paleontologists can be fairly confident that if fossils of certain animals are not found in the appropriately aged beds along with the abundant bones of many other animals of the same body size, the former creatures were almost certainly absent from the region. Even small bone fragments of large-boned animals are extremely durable, so paleontologists can determine that the animals were present, no matter how small the fossilized fragment.

These considerations have important implications for nearly all the large-bodied cryptids, such as Bigfoot, Nessie, and Mokele Mbembe. If they have lived in their respective homelands for as long as cryptozoologists assert, they would have left fossil records. The skeletons of Bigfoot and Nessie would be exposed in the Ice Age deposits of the Pacific Northwest and Scotland, as are those of other large animals once native to North America and Great Britain, like mammoths and mastodons. Instead, there is no evidence of their existence anywhere in the fossil record.

From the excellent worldwide fossil record, paleontologists can determine exactly which regions had which dinosaurs and marine reptiles in the Mesozoic era, or Age of Dinosaurs (250–65 million years ago). More important, the

complete absence of *any* dinosaur fossils (other than those of birds, which are surviving dinosaurs) in beds younger than 65 million years is strong evidence that no nonavian dinosaurs or large marine reptiles survived the mass extinction at the end of the Cretaceous period (144–65 million years ago). This argument applies to the plesiosaur-like Nessie and the sauropod-like Mokele Mbembe.

Plesiosaur fossils are common in marine beds deposited during the later part of the Mesozoic era (Jurassic [206–144 million years ago] and Cretaceous periods), and even plesiosaur vertebrae and teeth are distinctive and identifiable. Extensive marine deposits laid down after 65 million years ago are full of fossil sharks and other fish, whales, seals and sea lions, and other marine animals from all over the world. The collections of these fossils, especially in rich beds like Calvert Cliffs in Maryland and Sharktooth Hill Bone Bed in California, are enormous. Indeed, there are so many fossils of so many different marine animals that it is extremely unlikely that a creature as large as a plesiosaur swam in Chesapeake Bay, the Temblor Sea (present-day San Joaquin Valley), and Loch Ness and yet has never shown up in any fossil beds anywhere in the world that date to the Cenozoic era (65 million years ago–present). This record is good enough that the absence of evidence *is* evidence of absence.

The excellent fossil record for mammals and other animals that have lived in Africa over the past 65 million years not only is proof that no dinosaurs—such as Mokele Mbembe—survived on that continent, but also shows what animals (including some very large ones, such as early mastodons and the horned, rhino-like *arsinoitheres*) have lived in Africa since the beginning of the Cenozoic.⁶¹ Once again, the fossil record is good enough that the absence of evidence of dinosaurs in Africa is enough evidence of their absence.



Now that we have an understanding of how scientists work and how they might investigate claims about the reality of major cryptids, we can begin our exploration of these wondrous creatures.

1. CRYPTOZOOLOGY

- 1 “Americans ‘Find Body of Bigfoot,’” August 15, 2008, BBC News, <http://news.bbc.co.uk/2/hi/americas/7564635.stm>; “CNN—Has Bigfoot Been Found?” August 17, 2008, YouTube, <http://www.youtube.com/watch?v=OMrKrphWAEk&feature=related>; Ki Mae Heussner, “Legend of Bigfoot: Discovery? Try Hoax,” August 15, 2008, ABC News, <http://abcnews.go.com/Technology/story?id=5583488&page=1>; “Bigfoot Body Found in Georgia!!!!” August 14, 2008, YouTube, <http://www.youtube.com/watch?v=4NzB5xftSDY> (all accessed October 10, 2011).
- 2 “Georgia Bigfoot Tracker,” August 14, 2008, YouTube, http://www.youtube.com/watch?v=e_zFoCo_Tnc (accessed October 10, 2011).
- 3 Writing about the collaboration between “fast-talking Tom Biscardi” and Bigfoot hoaxer Ivan Marx, reporter Richard Harris was already asking in 1973 whether the for-profit team was composed of “adventurers or con-men” (“The Bigfoot: Fact, Fiction, or Flim-Flam?” *Eureka [Calif.] Times-Standard*, June 8, 1973, 13).
- 4 Matthew Moneymaker, “The 2008 Dead Bigfoot Hoax from Georgia,” Bigfoot Field Researchers Organization, <http://www.bfro.net/hoax.asp#biscardi> (accessed October 10, 2011).
- 5 “HOAX! Georgia Bigfoot Body Press Conference,” August 15, 2008, YouTube, <http://www.youtube.com/watch?v=pEinriwAPnQ> (accessed October 10, 2011).
- 6 The image is available at “Georgia Gorilla: Bigfoot Body’s First Photo,” August 12, 2008, CryptoMundo, <http://www.cryptomundo.com/cryptozoo-news/ga-gorilla-pic/> (accessed October 10, 2011).

- 7 “Alleged ‘Bigfoot’ Finders: Costume Was Filled with Roadkill,” August 20, 2008, WSB-TV, <http://www.wsbtv.com/news/news/alleged-bigfoot-finders-costume-was-filled-with-ro/nFBhF/> (accessed February 7, 2012).
- 8 Quoted in Paul Wagenseil, “Bigfoot Body Revealed to Be Halloween Costume,” August 20, 2008, Fox News, <http://www.foxnews.com/story/0,2933,406101,00.html> (accessed October 10, 2011).
- 9 “Bigfoot Hoaxers Say It Was Just ‘a Big Joke,’” August 21, 2008, CNN, <http://edition.cnn.com/2008/US/08/21/bigfoot.hoax/> (accessed February 7, 2012).
- 10 Quoted in Steve Bass, “NGCSU Prof Shed Light on Bigfoot Hoax,” November 6, 2008, *The Saint: The Online Student Newspaper for North Georgia College and State University*, <http://www.ngcsuthesaint.com/2008/11/ngcsu-prof-shed-light-on-bigfoot-hoax/> (accessed October 10, 2011).
- 11 For an excellent essay on the way science is practiced and the way creationists subvert these processes, see Stephen Jay Gould, “An Essay on a Pig Roast,” *Natural History*, January 1989, 14–25, reprinted in *Bully for Brontosaurus: Reflections in Natural History* (New York: Norton, 1991), 432–447.
- 12 Carl Sagan, *The Demon-Haunted World: Science as a Candle in the Darkness* (New York: Ballantine, 1996), 30.
- 13 Michael Shermer, *The Believing Brain: From Ghosts and Gods to Politics and Conspiracies: How We Construct Beliefs and Reinforce Them as Truths* (New York: Holt, 2011).
- 14 Michael Shermer, *Why People Believe Weird Things: Pseudoscience, Superstition, and Other Confusions of Our Time* (New York: Freeman, 1997), 48; Sagan, *Demon-Haunted World*, 10.
- 15 “Carl Sagan on Alien Abduction,” *Nova*, February 27, 1996, <http://www.pbs.org/wgbh/nova/space/sagan-alien-abduction.html> (accessed December 22, 2011); Marcello Truzzi, “On the Extraordinary: An Attempt at Clarification,” *Zetetic Scholar* 1 (1978): 11.
- 16 National Center for Science Education, “Project Steve,” October 17, 2008, <http://ncse.com/taking-action/project-steve> (accessed October 10, 2011).
- 17 Cryptozoological Realms, “Cryptozoology Biographies,” http://www.cryptozoology.net/english/biographies/biographies_index.html (accessed October 10, 2011).
- 18 See, for example, John Bindernagel, *North America’s Great Ape: The Sasquatch* (Courtenay, B.C.: Beachcomber Books, 1998), x.
- 19 Loren Coleman and Jerome Clark, *Cryptozoology A to Z: The Encyclopedia of Loch Monsters, Sasquatch, Chupacabras, and Other Authentic Mysteries of Nature* (New York: Simon and Schuster / Fireside, 1999), 102.
- 20 See, for example, British Columbia Scientific Cryptozoology Club, “Mokele Mbembe,” <http://bcsc.ca/mokele.htm> (accessed January 28, 2012).
- 21 Daniel Loxton asked the Southern Association of Colleges and Schools Commission on Colleges (the regional accreditation body for degree-granting higher-education institutions in Georgia and other southern states) whether Immanuel Baptist College has ever been accredited to grant academic degrees in Georgia. A representative responded, “Immanuel Baptist College has never been accredited by SACSCOC” (Terri Latimer, e-mail to Daniel Loxton, February 15, 2012).

- 22 *In the Matter of Warnborough College*, Docket Nos. 95-164-ST and 96-60-SF, United States Department of Education, August 9, 1996, <http://oha.ed.gov/cases/1995-164st.html> (accessed February 5, 2012).
- 23 Sarah Lyall, "Americans Say a College Near Oxford Duped Them," *New York Times*, October 2, 1995, <http://query.nytimes.com/gst/fullpage.html?res=990CE1D91531F931A35753C1A963958260> (accessed February 5, 2012).
- 24 Ben S. Roesch and John L. Moore, "Cryptozoology," in *The Skeptic Encyclopedia of Pseudoscience*, ed. Michael Shermer (New York: ABC-Clío, 2002), 1:71-78.
- 25 Darren Naish, e-mail to Daniel Loxton, February 5, 2012.
- 26 Matt Cartmill, reviews of *Bigfoot Exposed: An Anthropologist Examines America's Enduring Legend*, by David J. Daegling, and *Sasquatch: Legend Meets Science*, by Jeff Meldrum, *American Journal of Physical Anthropology* 135, no. 1 (2008): 117-118; David J. Daegling, *Bigfoot Exposed: An Anthropologist Examines America's Enduring Legend* (Lanham, Md.: Altamira Press, 2004).
- 27 Thomas Henry Huxley, "Biogenesis and Abiogenesis" (1870), in *Critiques and Addresses* (London: Macmillan, 1873), 229.
- 28 Quoted in Michael Shermer, "Show Me the Body," *Scientific American*, May 2003, <http://www.michaelshermer.com/2003/05/show-me-the-body/> (accessed October 10, 2011).
- 29 Elizabeth F. Loftus and Katherine Ketcham, *Witness for the Defense: The Accused, the Eyewitness, and the Expert Who Put Memory on Trial* (New York: St. Martin's Press, 1991); Austin Cline, "Eyewitness Testimony and Memory," About.com, <http://atheism.about.com/od/parapsychology/a/eyewitness.htm> (accessed October 10, 2011).
- 30 Daniel Simons, "Selective Attention Test," March 10, 2010, YouTube, <http://www.youtube.com/watch?v=vJG698U2Mvo> (accessed October 10, 2011).
- 31 A. Leo Levin and Harold Kramer, *Trial Advocacy Problems and Materials* (Mineola, N.Y.: Foundation Press, 1968), 269.
- 32 Elizabeth F. Loftus, *Memory: Surprising New Insights into How We Remember and Why We Forget* (New York: Addison-Wesley, 1980), 37.
- 33 Benjamin Radford and Joe Nickell, *Lake Monster Mysteries: Investigating the World's Most Elusive Creatures* (Lexington: University Press of Kentucky, 2006), 160-163.
- 34 Quoted in Elsbeth Bothe, "Facing the Beltway Snipers, Profilers Were Dead Wrong," *Baltimore Sun*, December 15, 2002, http://articles.baltimoresun.com/2002-12-15/entertainment/0212160297_1_van-zandt-serial-killers-snipers (accessed October 10, 2011).
- 35 David Rennie, "Sniper Police Deny 'White Man in White Van' Theory Hampered Search," *Telegraph*, October 28, 2002, <http://www.telegraph.co.uk/news/worldnews/northamerica/usa/1411536/Sniper-police-deny-white-man-in-white-van-theory-hampered-search.html> (accessed November 21, 2012).
- 36 Shermer, *Why People Believe Weird Things*, 88-89.
- 37 Ibid., 89-91.
- 38 Susan A. Clancy, *Abducted: How People Come to Believe They Were Kidnapped by Aliens* (Cambridge, Mass.: Harvard University Press, 2005), 33.
- 39 The search for the cryptid Mokele Mbembe provides a stark example: the interrogation of Congolese villagers by Roy Mackal's armed party in 1981. When local informants de-

nied knowledge of the creature, Mackal “confronted” them with “a barrage of information” until they became “visibly disturbed, and some, in their confusion, admitted to a great deal more knowledge” (*A Living Dinosaur? In Search of Mokele-Mbembe* [Leiden: Brill, 1987], 160).

- 40 See, for example, Loren Coleman, “The Meaning of Cryptozoology: Who Invented the Term Cryptozoology?” 2003, *The Cryptozoologist*, www.lorencoleman.com/cryptozoology_faq.html (accessed February 12, 2011), and “Cryptozoology’s Fathers,” June 19, 2010, *CryptoMundo*, <http://www.cryptomundo.com/cryptozoo-news/czfather/> (accessed May 5, 2012).
- 41 Bernard Heuvelmans, *Sur la piste des bêtes ignorées* (Paris: Librairie Plon, 1955); Lucien Blancou, *Géographie cynégétique du monde* (Paris: Presses Universitaires de France, 1959).
- 42 Bernard Heuvelmans, *In the Wake of the Sea Serpents*, trans. Richard Garnett (New York: Hill and Wang, 1968), 508.
- 43 The word “cryptozoological” appears at a line break and so is hyphenated: “cryptozoological.” It is unknown if the reviewer intended the word to have a hyphen, but he used it in much the same way that writers use it today. See Ralph Thompson, review of *The Lungfish and the Unicorn*, by Willy Ley, *New York Times*, April 22, 1941, 19; and Willy Ley, *The Lungfish and the Unicorn: An Excursion into Romantic Zoology* (New York: Modern Age Books, 1941).
- 44 A. C. Oudemans, *The Great Sea-serpent: An Historical and Critical Treatise. With the Reports of 187 Appearances . . . the Suppositions and Suggestions of Scientific and Non-scientific Persons, and the Author’s Conclusions* (Leiden: Brill, 1892).
- 45 Coleman and Clark, *Cryptozoology A to Z*.
- 46 Darren Naish, “Monster Hunting? Well, No. No,” October 10, 2007, *Tetrapod Zoology*, http://scienceblogs.com/tetrapodzoology/2007/10/monster_hunting_well_no_no.php (accessed October 10, 2011).
- 47 Bernard Heuvelmans, “How Many Animal Species Remain to Be Discovered?” *Cryptozoology* 2 (1983): 5.
- 48 Bernard Heuvelmans, “Annotated Checklist of Apparently Unknown Animals with Which Cryptozoology Is Concerned,” *Cryptozoology* 5 (1986): 1–26.
- 49 Naish, “Monster Hunting?”
- 50 Darren Naish, “Multiple New Species of Large Living Mammal,” June 1, 2007, *Tetrapod Zoology*, http://scienceblogs.com/tetrapodzoology/2007/06/multiple_new_species_of_large.php (accessed October 10, 2011).
- 51 Ralph M. Wetzell, Robert E. Dubos, Robert L. Martin, and Philip Myers, “*Catagonus*, an ‘Extinct’ Peccary, Alive in Paraguay,” *Science* 189 (1975): 379–381.
- 52 N. F. Goldsmith and I. Yanai-Inbar, “Coelacanthid in Israel’s Early Miocene? *Latimeria* Tests Schaeffer’s Theory,” *Journal of Vertebrate Paleontology* 17, supplement 3 (1997): 49A; T. Ørvig, “A Vertebrate Bone from the Swedish Paleocene,” *Geologiska Föreningens i Stockholm Förhandlingar* 108 (1986): 139–141.
- 53 Michael A. Woodley, Darren Naish, and Hugh P. Shanahan, “How Many Extant Pinniped Species Remain to Be Described?” *Historical Biology* 20 (2008): 225–235.

- 54 Darren Naish, e-mail to Daniel Loxton, April 30, 2012.
- 55 Andrew R. Solow and Woollcott K. Smith, "On Estimating the Number of Species from the Discovery Record," *Proceedings of the Royal Society B* 272 (2005): 285–287.
- 56 So devastating has the beetle infestation become in the new global-warming climate regime that British Columbia's forest industry currently depends on the logging of dead trees that were killed five or ten years ago by beetles. With the looming exhaustion of these stands of dead trees as a result of urgent harvesting, fires, and rot, the province faces such a catastrophic shortage of trees that its government has considered opening up the remaining protected areas of forest for logging—not to save the industry, but simply to *delay* the predicted loss of 11,000 forestry jobs. See, for example, "Confidential Pine Beetle Report Warns of 'Economic and Social' Havoc," April 18, 2012, CBC News, <http://www.cbc.ca/news/canada/british-columbia/story/2012/04/18/bc-timber-supply-mpb.html> (accessed April 28, 2012).
- 57 James H. Brown and Brian A. Maurer, "Macroecology: The Division of Food and Space Among Species on Continents," *Science* 243 (1989): 1145–1150. Other important publications include James H. Brown, Pablo A. Marquet, and Mark L. Taper, "Evolution of Body Size: Consequences of an Energetic Definition of Fitness," *American Naturalist* 142 (1993): 573–584; James H. Brown and Brian A. Maurer, "Evolution of Species Assemblages: Effects of Energetic Constraints and Species Dynamics on the Diversification of the North American Avifauna," *American Naturalist* 130 (1987): 1–17; James H. Brown and Paul F. Nicoletto, "Spatial Scaling of Species Composition: Body Masses of North American Land Mammals," *American Naturalist* 138 (1991): 1478–1512; William A. Calder III, *Size, Function, and Life History* (Cambridge, Mass.: Harvard University Press, 1984); John Damuth, "Home Range, Home Range Overlap, and Species Energy Use Among Herbivorous Mammals," *Biological Journal of the Linnean Society* 15 (1981): 185–193; A. S. Harestad and F. L. Bunnell, "Home Range and Body Weight—A Reevaluation," *Ecology* 60 (1979): 389–402; Stan L. Linstedt, Brian J. Miller, and Steven W. Buskirk, "Home Range, Time, and Body Size in Mammals," *Ecology* 67 (1986): 413–418; Brian K. McNab, "Bioenergetics and the Determination of Home Range Size," *American Naturalist* 47 (1963): 133–140; Robert Henry Peters, *The Ecological Implications of Body Size* (New York: Cambridge University Press, 1983); Michael Reiss, "Scaling of Home Range Size: Body Size, Metabolic Needs and Ecology," *Trends in Ecology and Evolution* 3 (1988): 85–86; Marina Silva and John A. Downing, "The Allometric Scaling of Density and Body Mass: A Nonlinear Relationship for Terrestrial Mammals," *American Naturalist* 145 (1995): 704–727; and Robert K. Swihart, Norman A. Slade, and Bradley J. Bergstrom, "Relating Body Size to the Rate of Home Range Use in Mammals," *Ecology* 69 (1988): 393–399.
- 58 Johan T. du Toit, "Home Range–Body Mass Relations: A Field Study on African Browsing Ruminants," *Oecologia* 85 (1990): 301–303.
- 59 Robert H. MacArthur and Edward O. Wilson, *Theory of Island Biogeography* (Princeton, N.J.: Princeton University Press, 1967).
- 60 Donald R. Prothero and Robert H. Dott Jr., *Evolution of the Earth*, 7th ed. (Dubuque, Iowa: McGraw-Hill, 2004), chap. 1.

- 61 Lars Werdelin and William Joseph Sanders, eds., *Cenozoic Mammals of Africa* (Berkeley: University of California Press, 2010).